The Behavior Analyst 1986, 9, 27–34 No. 1 (Spring)

Competition: Some Behavioral Issues

David R. Schmitt
University of Washington

Conclusions drawn from research in the social sciences comparing the quality or quantity of performance under cooperation and competiton stress the advantages of cooperation. This generalization may be premature, however, because of the paucity of experimental analyses investigating variations in competitive conditions. Neglected in particular have been variables that affect reinforcement conditions among competitors. These include performance differences, the basis of reinforcement, reinforcer distribution, and stimuli that indicate the performances of other competitors. These variables provide the basis for a behavioral interpretation of performance under competition. The result is a clearer understanding of the options that are available in instituting competitive contingencies and the areas in which experimental analyses are needed.

The ubiquitous supervisor-subordinate work setting has been the model for a longstanding research tradition in the social sciences. Prototypes include the teacher-student and supervisor-worker relations, in which contingencies are imposed on groups of subordinates in order to maximize the quality or quantity of some specified response. These contingencies have included (a) competition, in which a given reinforcer is distributed unequally to persons based on their relative performances; (b) cooperation, in which every person's performance is reinforced when a group performance standard has been met; and (c) an individual contingency, in which a person receives a reinforcer when a personal performance standard has been met.

A lengthy social science literature, principally in social and educational psychology, has compared the quality and quantity of performance under these alternatives—most frequently cooperation and competition—in academic classrooms and laboratory problem-solving groups (for reviews see Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Miller & Hamblin, 1963; Rosenbaum, 1979; Schmitt, 1981, 1984; Slavin, 1977, 1983). The conclusions drawn from this literature emphasize several advantages of cooperation over competition. First, performance is high under cooperation for various types of tasks, whereas it is high under competition only for particular tasks—namely those whose solution requires little or no collaboration among those working on them (Miller & Hamblin, 1963; Schmitt, 1981). Where the task requires collaborative activities such as response coordination, task subdivision, or information sharing, competitive contingencies are ineffective because they fail to reinforce, and may punish, such behaviors (e.g., helping other competitors may make their performances superior to yours). Collaboration is differentially reinforced under cooperative contingencies, however, because it increases the likelihood that the reinforcement criterion will be met. Second, when situations require no collaborative activities and are therefore suitable for competition, competitive performances are little if any better than cooperative ones (Johnson et al., 1981; Miller & Hamblin, 1963; Schmitt, 1981). Third, people report greater satisfaction with the task and those working with them under cooperation (Johnson, Johnson, & Maruyama, 1983; Slavin, 1977, 1983). Such findings have led some to urge the wider implementation of cooperative contingencies in education (Johnson et al., 1981; Slavin, 1983).

In spite of these conclusions, competition is still widely used and promoted

This work was supported in part by Grant SES-821437 from the National Science Foundation. I wish to thank Michelle Fogus and the reviewers for their helpful comments. Reprints may be obtained from David R. Schmitt, Department of Sociology (DK-40), University of Washington, Seattle, WA 98195.

in education and industry. One reason may be the greater ease with which competitive contingencies can be imposed by a third party—a teacher or an employer, for example. For competition, ascertaining what performances are to be reinforced is straightforward. Performances are simply rank ordered, often in terms of readily discernible dimensions such as quantity or speed. For cooperation, the problem is more complex. A criterion for reinforcement (e.g., number of problems solved, or goods produced or sold) must be set by the administrator, and performance will suffer if a poor choice is made. For example, if the criterion is set too high to be achieved very often, persons may become discouraged and quit. Or if it is set too low and can be achieved very easily, persons will be working less than they might for the reinforcer.

Competition may also be widely used because the reinforcer amount needed for a given contest can be fixed in advance. In some circumstances, this may be an important advantage. For example, teachers may wish to limit the number of "A"s they give each term; employers may need to limit the number of promotions given. With cooperation, by contrast, total amount of the reinforcer dispensed varies, depending on how high the reinforcement criterion has been set and how well the people perform.

It is also possible that competitive conditions examined to date, and those upon which conclusions have been based, have been less productive than those used in applied settings. Competition has been subjected to very few experimental analyses of conditions that determine its effectiveness, whereas cooperation has been investigated in various research programs exploring a range of variables (e.g., Hake & Olvera, 1978; Lindsley, 1966; Marwell & Schmitt, 1975; Molm, 1981). The exceptions are studies by Cohen (1962) and Lindsley (1966) investigating the effects of prior social relations on competition. Neglected in particular have been variables that affect reinforcement conditions among competitors. Competition differs from cooperation or an individual contingency in an important respect. A change in the contingency (e.g., a change in the size of the reinforcer) cannot have an identical effect on the likelihood that each competitor's responses will be reinforced. Competition by definition requires unequal reinforcers. For example, consider two salespeople competing for a bonus that is doubled from the first to the second contest. Performances of the two may increase equally, but only the higher overall performance will be reinforced.

Thus, changes in the allotment of the reinforcers will have differential effects on the performances of competitors. Over a series of contests, the result will typically be a complex, intermittent schedule of reinforcement that is unique for each competitor (unlike cooperation or an individual contingency where all participants may experience the same reinforcement schedules). Contest conditions favorable to the performances of some competitors, then, are necessarily less favorable to the performances of others. But the effects are not necessarily symmetrical—gains in performance for some competitors may not be balanced by performance decrements for others, so the prediction of effects for the group is likely to be problematic.

The purpose of the present paper is to analyze how competitive contingencies affect performance by providing a behavioral interpretation of some factors that are likely to affect reinforcement, and hence performance. The factors to be discussed are (a) performance differences, (b) the basis of reinforcement, (c) reinforcer distribution, and (d) stimuli indicating the peformances of other competitors. In a few instances, previous research suggests likely effects, but most of the predictions are drawn on the basis of behavioral principles. This analysis will provide a clearer understanding of the range of options available when competitive contingencies are introduced, and of how the choice of options might affect overall performance. Generalizations regarding performance under competition are premature until the effects of these variables, inherent in any competitive situation, are better understood.

PERFORMANCE VARIATION WITHIN AND BETWEEN COMPETITORS

Current competitive contingencies, which have yet to be experienced, cannot affect initial performances. These performances should be a function of past task and competition history, as well as current instructions. If the competition history is extensive, aspects of the current situation (e.g., contingencies, reinforcers, responses, and competitors) may function as discriminative stimuli if they have been associated with differential reinforcement in previous settings.

The only previous research on this issue has shown that performance is facilitated by instructions describing the competitive contingencies. Buskist, Barry, Morgan, and Rossi (1984) found that instructed subjects responded more quickly in the early stages of their experiment than did those who were uninstructed. Church (1962) and Church, Millward, and Miller (1963) found that performance increases following instructions were too rapid to be explained by differential reinforcement alone.

With a series of competitive contests, the schedule of reinforcement in the current situation should eventually come to control performance. For a given competitor, two types of performance variation should affect this schedule. One is the variation between competitors in mean performance caused by differences in skill or training. The other is variation within each competitor's performance across contests. Sources of within-competitor variation could include changes in health, fatigue, or circumstances beyond the competitors' control that could hinder or facilitate performance (e.g., sales are affected by number of customers available; athletic performances are affected by weather). Or the likelihood of competitive behavior could change because of changes in the availability of the reinforcer elsewhere, as predicted by the matching relation between relative response rate and the relative frequency and magnitude of reinforcement (Herrnstein, 1970). For example, the effect of a given amount of money in maintaining a competitive response may depend on the total amount available to the person elsewhere. For within-competitor variation to increase, a given performance-facilitating or hindering factor must have an unequal effect across competitors.

Consider the effects of within- and between-competitor performance variation on the likelihood that a given increase in a competitive performance will be differentially reinforced. Reinforcement should be most likely when both within- and between-competitor variation are small. The likelihood of differential reinforcement should decline as either type of variation increases. When within-competitor variation increases, reinforcers among competitors should be distributed more evenly. For example, a sales contest may be won by an average salesperson if the more skilled competitors are ill. Poorer competitors may thus be more likely to continue to participate in the contests. When between-competitor variation is great and performance has little variability, reinforcers will go only to the superior competitor (cf. Slavin, 1977). Inferior competitors should eventually cease responding, and may withdraw from the situation. Schmitt (1976) observed this outcome in a study that allowed choice between cooperation and competition. The inferior competitor in three-person groups tended to quit the experiment. Matthews (1979) also found that as reinforcer inequities between two subjects increased, the disadvantaged partner tended to withdraw to an alternative response. In addition, the performance of superior competitors should decline because poorer, less effortful performances will continue to be reinforced.

A risk in highly competitive situations is that competitors will collude with regard to how they will perform. For example, competitors may arrange their performances so that each wins a predetermined proportion of the time (sharing the reinforcers), or they may split their earnings later. An occasional problem in American industries with oligopolies has been market sharing agreements. This behavior circumvents the intended ef-

fects of competition and usually reduces group performance significantly. Hake and his associates investigated sharing between two competitors and found that it was more likely the larger the number of responses required in each contest, and the more similar each subject's competitive earnings (Hake, Olvera, & Bell, 1975; Olvera & Hake, 1976).

BASIS FOR REINFORCEMENT

On what criteria are reinforcers to be awarded differentially? In order to have competition, two elements need to be specified. The first necessary element is a basis for ranking the competitors to ascertain whose performances will be reinforced. These performances can be ranked in two ways. The first is to rank them on the quality or quantity of some response; the second is to rank them on the time or number of attempts required to reach some response criterion. The second necessary element for competition is having a basis for ending the competitive contest. Contests can be concluded in two ways. Which one is used depends on which of the two ranking options is chosen.

If ranking is based on the quality or quantity of some response, then the contest end must be specified in terms of time or number of attempts allowed to make the response. Everyday examples of competition based on responses ranked after fixed periods include monthly sales contests where the salesperson with the highest sales receives a bonus, academic assignments such as term papers that are ranked in quality after a specified due date, and sports such as basketball or football where the number of points scored at the end of the game determines the winner.

If ranking is based on time or number of attempts required to reach a response criterion, then the contest end is determined by the particular criterion value that is chosen. Everyday examples of competition based on time taken (or attempts needed) to reach a fixed response criterion include employees competing for promotions or bonuses based on the time taken to complete assignments and races where competitors are ranked on time taken to travel a certain distance.

These two types of competition–based on responses ranked after fixed periods or the time taken to reach a fixed response criterion—describe competitive contests in which the criterion defining the end of the contest is known to the competitors. In some instances, however, the criterion defining the contest end is not known and varies across contests. With the contest-end variable, two other competitive variations can be described. Examples of competition based on responses ranked after variable periods include employees who are evaluated unexpectedly for promotion, or students who are graded on a curve on a pop quiz. An example of competition based on time taken (or attempts needed) to reach a variable response criterion might be the efforts by salespeople competing to sell a given product to a number of clients. Each client would finally purchase from only one salesperson, and the effort required to make the sale would be different for each client.

From the standpoint of each competitor, these combinations are examples of conjunctive schedules of reinforcement—two contingencies must be met for reinforcement to occur (Ferster & Skinner, 1957, p. 725). One contingency specifies the length of the competitive contest; the other specifies the ranking for reinforcement. Various conjunctive schedules have been studied (e.g., Duvinsky & Poppen, 1982; Zeiler & Buchman, 1979), but the four created under competition are not among them. Thus, few grounds exist for predicting how these bases of reinforcement might differ in their effects on competitive performance. One effect of basing contest length on response criteria instead of on time or number of competitive attempts is that competitive rate controls the rate of reinforcement. This may lead to higher competitive response rates in that response rates on ratio reinforcement schedules are higher than those on interval schedules (e.g., Ferster & Skinner, 1957, pp. 399–405).

When a particular reinforcer amount

is available for competition, the option of awarding it in a single contest or dividing it among several contests may exist. With the latter, variations in frequency and amount are possible. For example, $100 might be awarded in two contests of $50 each, five contests of $20 each, etc. Church (1968) suggests that increasing the length of the contest serves to increase the effects of the relative skills of the competitors. Because the performances of the less skilled competitors are reinforced less frequently, they should extinguish more rapidly. Church (1962) compared performance in contests of various lengths and obtained results consistent with this prediction. In the shortest contest, the responses of fewer than 10% of the subjects with the lower initial response rate extinguished; in the longest contest, extinction occurred in every case. But because Church did not make the reinforcer amounts proportionally higher in the longer contests, the effect may not have been caused by contest length alone.

When reinforcement is less frequent but reinforcer amounts are proportionally higher, some evidence suggests that a different outcome may result. Schmitt (1976) investigated the effects of group size on competition using contests where only a single competitor received a reinforcer, and the average reinforcer amounts for each person remained constant across different sized groups. The effect of increasing the size of the group under this condition is to decrease the likelihood of reinforcement for each competitor, but to increase the size of each reinforcer. For example, assume that each person averages $10 per contest. Each competitive reinforcer will be worth $20 in a two-person contest and $30 in a three-person contest. Schmitt found that reinforcer size affected the attractiveness of competition vis-à-vis cooperation when two- and three-person groups were compared. The larger, less frequent reinforcer produced more competition than the smaller, more frequent one. The same principle seems to apply to recent state lottery games, where contests with large, multimillion dollar payoffs and very low probabilities of winning have become more popular than contests with smaller but more frequent and immediate payoffs.

REINFORCER DISTRIBUTION

Competition requires that reinforcers be distributed unequally in each contest, but does not specify the particular form of inequality. Reinforcer distributions can have two properties. One is range, which is the proportion of competitors receiving reinforcers in each contest. At one extreme, only one competitor receives a reinforcer; at the other, all competitors do, but in varying amounts. The latter is tantamount to giving a reinforcer to each competitor that is noncontingent on performance—specifically, that amount received by the lowest performer—and, thus, seems to be a departure from a purely competitive contingency. One effect of this distribution should be the greater likelihood of maintaining some responding among all competitors.

When more than one competitor's response is reinforced, variation can occur in a second property, reinforcer differential, which is the difference between the highest and lowest reinforcer amounts in each contest. The wider the range (i.e., the more widely shared the reinforcer), the smaller the maximum differential can be. What range or reinforcer differentials produce the highest competitive performances? Ample evidence suggests that reinforcer size affects responding (e.g., Osborne, 1978), but there have been no parametric studies of human behavior that show the shape of the relation. Psychophysical studies suggest that motivation may be a power function of size (i.e., negatively accelerating) when the reinforcer is money (Breault, 1981). An understanding of the shape of the relation is needed in order to establish a distribution of reinforcer differences that will maximize competitors' responding.

INFORMATION ABOUT COMPETITORS' PERFORMANCES

Very often, a competitive contest includes a number of responses undertaken

over a period of time (e.g., sales contests, course grades, or promotions). Here competitors can be provided with stimuli indicating their relative performance during the contest. This could take the form of a performance rank or any other information that permits performance comparisons (e.g., grades or evaluations). Evidence indicates that when persons are working on separate, noncompetitive tasks, performance is facilitated by stimuli indicating that others' performances are slightly superior to one's own (Seta, 1982). In such situations, however, the performance stimuli are not related to the likelihood of reinforcement. This is not the case when subjects compete. In competition, the stimuli are associated with differential reinforcement, and thus should come to function as discriminative stimuli in controlling behavior. But, because reinforcement depends on the others' behavior as well as one's own, performance stimuli will usually not predict the relation between behavior and reinforcement perfectly. Hence, their control of behavior should often be weak.

Under what conditions might performance stimuli serve to increase or decrease a competitor's responding? Consider a situation with two competitors. The likelihood that an increase in a competitor's performance will be reinforced should be greater the more equal the two performances. A performance increase will be less likely to improve the chance of winning if a person is far ahead or far behind. Therefore, small differences should be more likely to serve as discriminative stimuli in increasing performance.

Whether an increase will occur should also depend on when the performance stimuli are provided during the contest. There are several reasons why stimuli revealing equal performances late in a contest should be more effective than stimuli provided early. First, a rate increase will have to be sustained for a shorter time in order to make reinforcement more probable. Second, other competitors have less time to respond with performance increases of their own. Third, late stimuli should be more reliable indicators of performance differences because they are based on larger samples of behavior. Fourth, late stimuli should have greater strength because of the shorter delay in reinforcement following the responses.

A decrease in performance by a competitor should be likely when it does not reduce the probability of reinforcement. The larger the performance difference between competitors, the less should be the likelihood that any change in performance will affect reinforcement. Hence, large differences should be more likely to serve as discriminative stimuli in reducing performance. Again, the effect should be greater the later the stimulus is provided in the contest.

With regard to application, these speculations suggest that peformance information should be provided frequently during contests if competitors are known to be similar in initial performances. For example, salespersons should be given frequent comparative sales information; competitors for a promotion should be given frequent evaluations showing relative performance. If performance differences are not known initially, performances early in the contest might be assessed for similarity. If the differences are not great, performance information could then be provided later in the contest, at a time when it should be particularly effective.

If performance stimuli serve a discriminative function, other aspects of their relation to competition could affect performance. One is schedule of availability. For example, the stimuli may be present continuously, intermittently, or at fixed or variable intervals. Another is whether or not competitors control the availability of the stimuli. Where competitors have the opportunity to make a response that provides them, the response is termed an audit (Hake & Olvera, 1978). The effects of these conditions on group performance have not been investigated.

CONCLUSION

Whenever competitive contingencies are implemented, some basis for reinforcement, some reinforcer distribution, and some condition regarding perfor-

mance information must be arranged. How much attention should be paid to variations in these elements in maximizing the performance of a group of competitors? The preceding analysis, centering on the effects of differential reinforcement and discriminative stimuli on performance, suggests that the choice has important consequences. Response rates of a group of competitors should be highest when contest length is based on response criteria instead of time, when contests extend for long periods with large reinforcers, and when a high proportion of competitors receive at least some of the reinforcer. Providing information to the competitors regarding relative performance, particularly if it is provided late in a contest, should increase performance when performance differences are small. No predictions were made regarding the effects of different reinforcer distributions among competitors or the presence or absence of performance information when performance differences are unknown.

This analysis has centered on competition in its simplest forms—a single contest or a series of contests, but has not considered competitive contingencies that are more complex. As one example, long contests occasionally incorporate a series of shorter ones. In some cases the results from the series are used to determine the overall winner, as in the championship series in professional baseball and basketball. In other cases the results do not contribute directly to the longer contest. For example, sales contests often occur independently of a larger contest for promotion based on sales. In bicycle racing riders often compete for prizes on selected laps as well as for the prize for victory. In all cases, though, the shorter contests necessarily provide performance stimuli that may bear on the longer contest, and they may be accompanied by a reduced reinforcer in the longer contest.

The various factors that could affect collective performance under competition thus comprise a lengthy research agenda. Their investigation will carry theoretical and applied significance for this major form of interdependence.

REFERENCES

Breault, K. (1981). The modern psychophysical measurement of marginal utility: A return to introspective cardinality? *Social Science Quarterly, 62,* 672–684.

Buskist, W. F., Barry, A., Morgan, D., & Rossi, M. (1984). Competitive fixed interval performance in humans: Role of "orienting" instructions. *The Psychological Record, 34,* 241–257.

Church, R. M. (1962). Effect of relative skill on the amount of competitive facilitation. *Psychological Reports, 11,* 603–614.

Church, R. M. (1968). Applications of behavior theory to social psychology: Imitation and competition. In E. C. Simmel, R. A. Hoppe, & G. A. Milton (Eds.), *Social facilitation and imitative behavior* (pp. 135–167). Boston: Allyn & Bacon.

Church, R. M., Millward, R. B., & Miller, P. (1963). Prediction of success in a competitive reaction time situation. *Journal of Abnormal and Social Psychology, 67,* 234–240.

Cohen, D. J. (1962). Justin and his peers: An experimental analysis of a child's social world. *Child Development, 33,* 697–717.

Duvinsky, J. D., & Poppen, R. (1982). Human performance on conjunctive fixed-interval fixed-ratio schedules. *Journal of the Experimental Analysis of Behavior, 37,* 243–250.

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement.* New York: Appleton-Century-Crofts.

Hake, D. F., & Olvera, D. (1978). Cooperation, competition and related social phenomena. In A. C. Catania & T. A. Brigham (Eds.), *Handbook of applied behavior analysis: Social and institutional processes* (pp. 208–245). New York: Irvington.

Hake, D. F., Olvera, D., & Bell, J. C. (1975). Switching from competition to sharing or cooperation at large response requirements: Competition requires more responding. *Journal of the Experimental Analysis of Behavior, 24,* 343–354.

Herrnstein, R. J. (1970). On the law of effect. *Journal of the Experimental Analysis of Behavior, 13,* 243–266.

Johnson, D. W., Maruyama, G., Johnson, R., Nelson, D., & Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89,* 47–62.

Johnson, D. W., Johnson, R. T., & Maruyama, G. (1983). Interdependence and interpersonal attraction among heterogeneous and homogeneous individuals: A theoretical formulation and a meta-analysis of research. *Review of Educational Research, 53,* 5–54.

Lindsley, O. R. (1966). Experimental analysis of cooperation and competition. In T. Verhave (Ed.), *The experimental analysis of behavior: Selected readings* (pp. 470–501). New York: Appleton-Century-Crofts.

Marwell, G., & Schmitt, D. R. (1975). *Cooperation: An experimental analysis.* New York: Academic Press.

Matthews, B. A. (1979). Effects of fixed and al-

ternated payoff inequity on dyadic competition. *The Psychological Record, 29,* 329–339.

Miller, L. K., & Hamblin, R. L. (1963). Interdependence, differential rewarding, and productivity. *American Sociological Review, 28,* 768–778.

Molm, L. D. (1981). A contingency change analysis of the disruption and recovery of social exchange and cooperation. *Social Forces, 59,* 729–751.

Olvera, D. R., & Hake, D. F. (1976). Producing a change from competition to sharing: Effects of large and adjusting response requirements. *Journal of the Experimental Analysis of Behavior, 26,* 321–333.

Osborne, S. R. (1978). A quantitative analysis of the effects of amount of reinforcement on two response classes. *Journal of Experimental Psychology: Animal Processes, 4,* 297–317.

Rosenbaum, M. E. (1979). Cooperation and competition. In P. B. Paulus (Ed.), *Psychology of group influence* (pp. 291–331). Hillsdale, NJ: Lawrence Erlbaum.

Schmitt, D. R. (1976). Some conditions affecting the choice to cooperate or compete. *Journal of the Experimental Analysis of Behavior, 25,* 165–178.

Schmitt, D. R. (1981). Performance under cooperation or competition. *American Behavioral Scientist, 24,* 649–679.

Schmitt, D. R. (1984). Interpersonal relations: Cooperation and competition. *Journal of the Experimental Analysis of Behavior, 42,* 377–383.

Seta, J. J. (1982). The impact of comparison processes on coactors' task performance. *Journal of Personality and Social Psychology, 42,* 281–291.

Slavin, R. E. (1977). Classroom reward structure: An analytical and practical review. *Review of Educational Research, 47,* 633–650.

Slavin, R. E. (1983). When does cooperative learning increase student achievement? *Psychological Bulletin, 94,* 429–445.

Zeiler, M. D., & Buchman, I. B. (1979). Response requirements as constraints on output. *Journal of the Experimental Analysis of Behavior, 32,* 29–49.